Gibsonville Healthy Forest Restoration Project

Plumas National Forest

Feather River Ranger District

Hydrology Report

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Hydrology

Introduction

Protection of water quality and quantity is an important part of the Forest Service's mission (USDA Forest Service 2007b). Management activities on national forest lands must be planned and implemented to protect the hydrologic functions of forest watersheds, including the volume, timing, and quality of streamflow. The Clean Water Act of 1948 (as amended in 1972 and 1987) establishes as federal policy the control of point and non-point source pollution and assigns to the States primary responsibility over control of water pollution. The Forest Service is required to protect and enhance existing and potential beneficial uses during water quality planning (California Regional Water Quality Control Board [CRWQCB], 1998). Compliance with the Clean Water Act by national forests in California is achieved under state law (see below). Beneficial uses are defined under California State law in order to protect against degradation of water resources and to meet state water quality objectives. The 1988 Plumas National Forest Land and Resource Management Plan states: "maintain or, where necessary, improve water quality using Best Management Practices (BMPs)." BMPs are procedures, techniques, and mitigation measures that are incorporated in all Plumas National Forest actions to protect water resources and prevent or diminish adverse effects to water quality. Subsequent Forest Plan standards and guides state: "implement BMPs to meet water quality objectives and improve the quality of surface water on the Forest."

This report utilizes the Equivalent Roaded Acres (ERA) model to assess cumulative watershed effects (USDA Forest Service 1990). ERA coefficients are used to estimate the effect of management activities such as timber harvest, pile burning, and underburning comparable to the effect of a road in terms of altering surface runoff patterns and timing. Watersheds and their associated stream systems can absorb some level of land disturbance without causing unacceptable effects to beneficial uses of water. However, there is a point where additive or synergistic effects of land use activities would cause a watershed to become highly susceptible to cumulative effects. For the Forest Service ERA model, the estimated upper limit of watershed tolerance is called the threshold of concern (TOC). The TOC does not represent an exact level of disturbance above which cumulative watershed effects will occur. Rather, it serves as an indicator of increased risk of significant adverse cumulative effects occurring within a watershed. The land management activities proposed under this project have the potential to affect watershed resources in a beneficial, indifferent, or adverse manner, either through direct, indirect, or cumulative effects, as described in detail below.

Analysis Framework: Statute, Regulatory Environment, Forest Plan and Other Direction

The Gibsonville Healthy Forest Restoration Project is designed to fulfill the management direction specified in the 1988 Plumas National Forest Land and Resource Management Plan (PNF LRMP) (USDA 1988), as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) FSEIS and ROD (USDA 2004a,

b). Management activities are designed to comply with the standards and guidelines as described in the SNFPA FSEIS and ROD (USDA 2004a, b).

Organic Administration Act of 1897 – This act emphasizes that the Forest Reserves, currently known as National Forests, were created to improve and protect the forests within their boundaries; to secure favorable water flows; and to furnish a continuous supply of timber for the use and necessities of the citizens of the United States.

Clean Water Act - Clean Water Act of 1948 (as amended in 1972 and 1987) establishes as federal policy the control of both point and non-point pollution and assigns to the States the primary responsibility for control of water pollution.

National Forest Management Act – The National Forest Management Act (NFMA) of 1976 amended the Forest and Rangeland Renewable Resources Planning Act of 1974. This authority requires the maintenance of productivity of the land and the protection and, where appropriate, the improvement of the quality of soil and water resources. The Act specifies that substantial and permanent impairment of productivity must be avoided.

State Water Quality Management Plan – From 2000 until 2011, non-point source pollution on Plumas National Forest was managed through the water quality management program contained in Water Quality Management for Forest System Lands in California (USDA, 2000). The Best Management Practices (BMPs) contained in that document have recently been improved and replaced by the BMPs presented in a Region 5 amendment to the Forest Service Handbook (see below). The 2000 State Water Quality Management Plan contains the 1981 Management Agency Agreement (MAA) between the California State Water Resources Control Board and the USDA, Forest Service. The State Board has designated the Forest Service as the management agency for all activities on National Forest lands.

Region 5 2011 Amendment to the Forest Service Soil and Water Conservation Handbook - The Pacific Southwest Region (Region 5) of USDA-Forest Service has recently adopted an amendment to the Forest Service Handbook, Section 2509.22, Chapter 10 (Water Quality Management Handbook) (USDA Forest Service 2011). This handbook improves and replaces the Best Management Practices presented in Water Quality Management for Forest System Lands in California (see above). The Forest Service water quality protection program relies on implementation of BMPs. Best Management Practices are procedures, techniques, and design features that are incorporated in project actions that have been determined by the State of California to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. Improvements to Forest Service BMPs, as presented in the 2011 Handbook amendment include more detailed descriptions of individual BMPs (section 12), a requirement that site-specific BMPs be included in timber sale contracts (section 13), and direction that legacy sites (sites disturbed by previous land use that is causing or has potential to cause adverse effects to water quality) within timber project boundaries will be restored or improved. Additionally, the 2011 Handbook amendment establishes an expanded water quality management monitoring program (section 16). BMPs applicable to the Gibsonville Healthy Forest Restoration Project are 1.1-6, 1.8-17, 1.19-21, 2.2-6, 2.8, 2.11, 5.2-3, and 5.6.

The Water Quality Management Handbook discussed in this section is expected to be updated later this year.

National Best Management Practices - In addition to BMPs prescribed in the Region 5 amendment to the Forest Service Handbook, BMPs presented in National Best Management Practices for Water Quality Management on National Forest System Lands (USDA Forest Service 2012) are also applicable to activities proposed in the project. These BMPs are Mechanical Vegetation Management Activities: 1-4, 6, and 8. Other applicable BMPs are for Road Management Activities: 1-7 and 1.9-10.

Section 303(d) of the Clean Water Act - The section requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards or are considered impaired. The list of affected water bodies, and associated pollutants or stressors, is provided by the State Water Resources Control Board (SWRCB). The most current list available is the 2010 Integrated Report on the SWRCB website (SWRCB 2010). There are no 303d listed water bodies within the immediate watershed boundaries. All five subwatersheds feed into Slate Creek which flows to the North Fork Yuba River which is 303d listed. A few miles down from its confluence the North Fork Yuba River flows into New Bullards Bar Reservoir which is 303d listed too. Both 303d list water features are on the list for mercury.

Beneficial Uses Identified by the CA Regional Water Quality Control Board (Central Valley Region) - Beneficial uses are defined under California State law in order to protect against degradation of water resources and to meet state water quality objectives. The Forest Service is required to protect and enhance existing and potential beneficial uses (California Regional Water Quality Control Board [CRWQCB] 1998). Beneficial uses of surface water bodies that may be affected by activities on the Forest are listed in Chapter 2 of the Central Valley Region's Water Quality Control Plan (commonly referred to as the "Basin Plan") for the Sacramento and San Joaquin River basins (CRWQCB 1998). The Basin Plan does not specify beneficial uses for Slate Creek. Slate Creek flows into the North Yuba River and then into then to New Bullards Bar Reservoir and eventually into Englebright Dam. The beneficial uses identified will be associated to Englebright Reservoir.

The Sierra Nevada Forest Plan Amendment (SNFPA) Record of Decision (ROD) -

The SNFPA ROD (USDA 2004) describes management direction for riparian areas and water resources located on Plumas National Forest System lands. The ROD includes six riparian conservation objectives (RCOs) and more than thirty standards and guidelines to be implemented for designated Riparian Conservation Areas (RCAs). Designation of appropriate widths of RCAs is an integral element of the riparian area management. The standard and guide for Riparian Conservation Area (RCA) widths suggested by the ROD are described below. RCA widths shown below may be adjusted at the project level if a landscape analysis has been completed and a site-specific Riparian Conservation Objectives (RCO) analysis demonstrates a need for different widths which did occur for this project. For more specifics on these two analyses see the appendix. The adjusted widths are listed and described in the "Treatment within RCAs and SMZs" section below.

- Perennial Streams: 300 feet on each side of the stream, measured from the bank full edge of the stream

- Seasonally Flowing Streams (includes intermittent and ephemeral streams): 150 feet on each side of the stream, measured from the bank full edge of the stream
- Streams in Inner Gorge: top of inner gorge
- Special Aquatic Features or Perennial Streams with Riparian Conditions extending more than 150 feet from edge of streambank or Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of streambank: 300 feet from edge of feature or riparian vegetation, whichever width is greater
- Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs
- Other hydrological or topographic depressions without a defined channel: RCA width and protection measures determined through project level analysis.

Plumas National Forest Land and Resource Management Plan (LRMP) - Forest Plan standards and guidelines provide the relevant substantive standards to comply with NFMA. The 1988 LRMP (USDA 1988) establishes standards and guidelines for protection and maintenance of Forest watersheds, water quality, and water supply, including:

- Implementation of BMPs.
- Establishment of Streamside Management Zones (SMZs) per guidelines in Appendix M of the LRMP. These guidelines were replaced by the standards and guidelines presented in the SNFPA ROD.
- Preparation of an SMZ plan for any activities that will occur within an SMZ, including a description of vegetation management objectives, needed erosion control measures, and an analysis of SMZ areas with over-steepened slopes or very high Erosion Hazard Rating (EHR). The SMZ plan for this project is included in project file.

Timber Harvest Activities Waiver Program – The Central Valley Water Board, issued a conditional waiver of waste discharge requirements for discharges related to timber harvesting activities in the Central Valley Region on January 30, 2003. It was later renewed on January 27, 2005; April 28, 2005 and on March 18, 2010, the Central Valley Water Board issued Order R5-2010-0022 (CRWQCB, 2014). Order No. R5-2014-0144 was adopted on December 4, 2014 which renewed the condition waiver of waste discharge. The Waiver specifies eligibility criteria and conditions that must be met by dischargers engaged in timber harvest activities on private and National Forest System lands in order to qualify for a waiver of waste discharge requirements. Dischargers submit Waiver Applications prior to commencement of timber harvest activities and Waiver Certifications at the conclusion of those activities. The waiver also imposes conditions and requirements for agency monitoring. Implementation monitoring is required for all projects and consists of non-random pre- and post-winter inspection of project BMPs during the course of timber harvest activities. It should be designed to focus on portions of the project that have the highest risk to water quality. Forensic and effectiveness monitoring are required for Federal projects only if “the discharger’s cumulative off-site watershed effects analysis indicates that the project, combined with other Forest Service projects conducted in the watershed over the past 10 years, may cause any watershed or sub-watershed to exceed a threshold of concern”

(CRWQCB, 2014). Forensic and effectiveness monitoring consist of winter inspection of sediment sources and BMPs to detect significant sources of pollution, to determine whether project-specific BMPs are effective in protecting water quality, and to assist in evaluating the overall effectiveness of the waiver program in protecting water quality and beneficial uses. Additional monitoring may be required if water quality protection measures fail or there are threats to water quality or beneficial uses from project activities. Detailed monitoring requirements and plans for the Gibsonville Healthy Forest Restoration Project are located in project file.

Effects Analysis

Geographic and Temporal Bounds

The scope of the Cumulative Watershed Effects (CWE) Analysis includes five subwatersheds ranging from 760 to 1,312 acres in size with a total analysis area of 5,330 acres (Table 1). All the subwatersheds that were created for the project fall within the Slate Creek six-level HUC (hydrologic Unit Code) subwatershed which is 39,323 acres. The typical six-level HUC subwatershed range from 10,000-40,000 acres. Slate Creek flows into the North Yuba River and then into then to New Bullards Bar Reservoir and eventually into Englebright Dam. The beneficial uses identified will be associated to Englebright Reservoir.

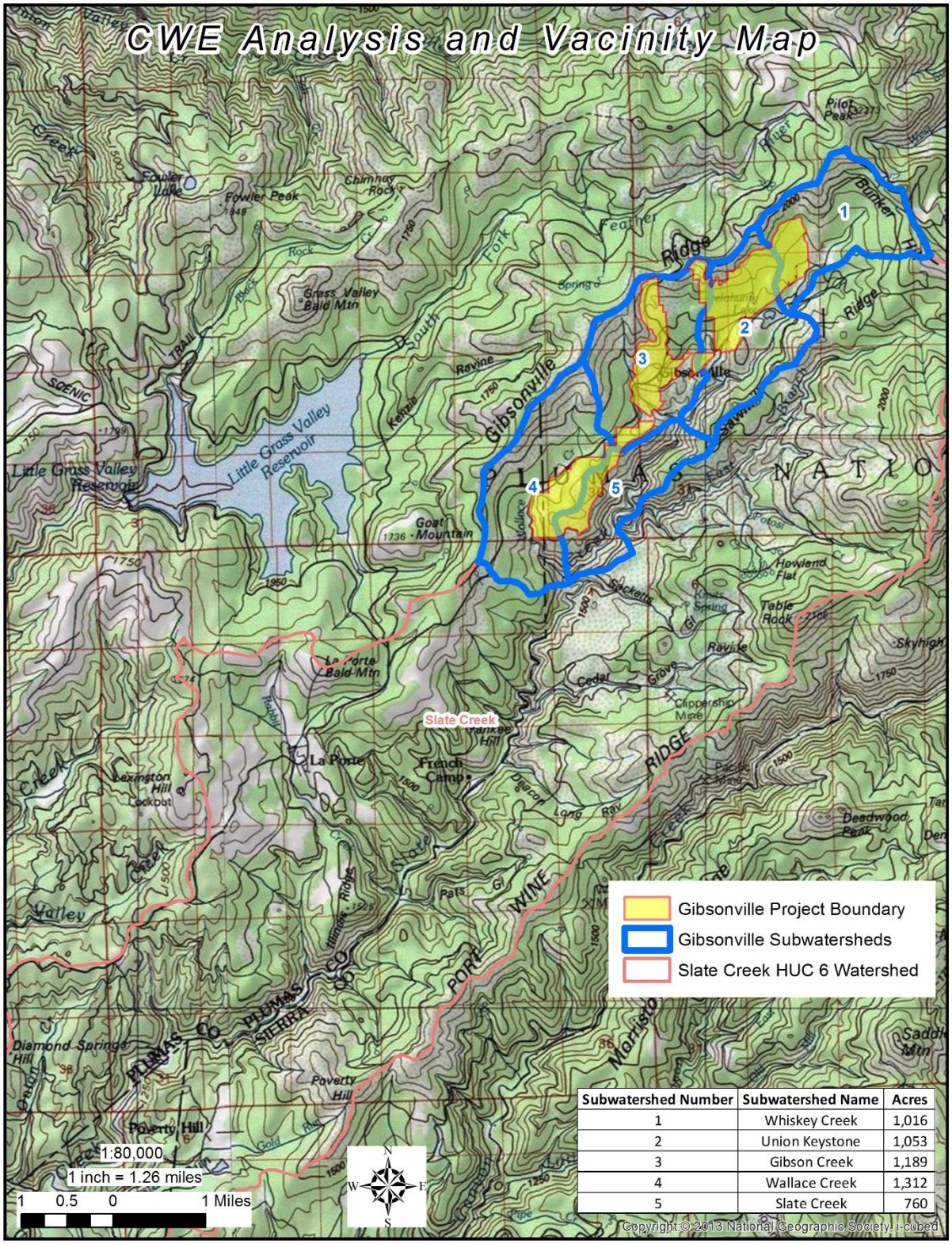
The annual average precipitation that the subwatersheds receive ranges from 69 to 85 inches (USDA 2007a). The annual average precipitation is data is derived from 1960-2001. The weighted annual average precipitation was determined to be 78 inches. Approximately 38.3 miles are identified as ephemeral, 14.5 miles as intermittent, and 16.8 miles as perennial streams. Approximately 2.3 acres of aspen where identified, 56.4 acres of meadow, and 27 springs.

Figure 1 depicts the location of the subwatersheds relative to the landscape and surrounding communities. The temporal bounds of direct and indirect effects are two fold, where impacts and improvements would be evident following the first runoff season post project. Depending on the type of treatments, impacts could potentially persist for several years or even decades, but would not be permanent. Improvements, when properly maintained, should persist for decades. For cumulative effects, a standard timeframe of 25 years is assumed for impacts to recover and for improvements to sustain unless overridden with other activity.

Table 1. Cumulative watershed effects (CWE) subwatershed description

Subwatershed Number	Subwatershed Name	Acres
1	Whiskey Creek	1,016
2	Union Keystone	1,053
3	Gibson Creek	1,189
4	Wallace Creek	1,312
5	Slate Creek	760

Figure 1. CWE Analysis and Vicinity Map



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Roads

Roads and trails were compiled to determine the number of miles and density by subwatershed for this report to get an overview of their impact on the landscape. The complied data came from road surveys, our corporate layers, and aerial photos. Table 2 indicates that the average density of roads and trails for the watershed analysis area is 4.0 miles of roads and trails per square mile. The density numbers are rated as good, fair or poor based on the Washington Office (WO) Forest Service Watershed Condition Classification Assessment (WCA) Guide (USDA Washington Office 2010). The following are how road densities are rated:

- Good = Road density < 1 mi/mi^2
- Fair = Road density of 1 – 2.4 mi/mi^2
- Poor = Road density > 2.4 mi/mi^2

Based on the average density of roads and trails it's rated as poor. No road decommissioning is presented or analyzed in the report because it's not part of the purpose and need. Due to the high road density, road surveys were conducted in 2012, 2013, and 2015 but the majority of the surveys occurred in 2012.

Table 2. Road Density by Subwatershed

Subwatershed Number	Density of roads and trails (mi/mi^2)					
	County Road	Forest Service System Roads	OHV Trails	Pacific Crest Trail	Unclassified Road	Grand Total
1	0.1	3.8	0.0	0.9	0.3	5.1
2	1.2	1.4	0.0	0.0	0.8	3.5
3	1.9	1.0	0.2	0.0	1.4	4.5
4	1.1	1.4	0.6	0.0	2.2	5.4
5	0.0	0.1	1.1	0.0	0.6	1.9
Average	0.9	1.5	0.4	0.2	1.1	4.0

The surveys primarily looked at stream crossing. The surveys looked to determine if it was a forded stream crossing or a typical culvert stream crossing. Regardless of the type of stream crossing the stream type was recorded. At the channel the upstream gradient, bankfull width, and wetted width were recorded. If it was a stream crossing with a culvert the size and number of culverts were recorded as well as the condition of the culvert, percent plugged or crushed, outlet drop, and evidence of overtopping. The 2013 and 2015 surveys were covering areas that we missed in 2012. These surveys indicate that no overtopping at culvert stream crossings occurred and the recommended action is to conduct general maintenance on the Forest Service system roads.

The 2012 road surveys had 18 culvert stream crossings which 4 were perennial streams and 14 were either intermittent or ephemeral streams. Surveys found that outlet drops at the stream crossings ranged from 0 feet to 3 feet, 7 were less than 1 foot, 11 were equal or greater than 1 foot, and 5 were equal or greater than 2 feet. Twelve of sixteen culvert stream crossings were on county roads and 9 of those had stream outlet drops equal or greater than 1 foot. **Review of the roads survey data of the Gibsonville project over past several years it's recommended that following stream crossing identified in Table 3 need the culverts to be replaced or reused and set properly where the outlet drop is close**

to zero feet. It's recommended that the haul routes have additional dips and critical dips before the implementation of the project. Critical dips are dips located adjacent to a culvert stream crossing that in the event of overtopping the flow is diverted back to the stream channel instead of going down the road prims to into another dip, ditch relieve culvert, or stream crossing.

Table 3. Recommended stream crossings that need work on

Road or Trail ID	Stream Type	Outlet Drop (ft.)
22N96Y	Intermittent	1
22N01X	Perennial	2
22N01X	Perennial	3
9M21	Ephemeral	1

Borax

Under the action alternatives the proposed treatment to deter the spread of Heterobasidion annosum (annosus) root disease would be performed by manual application of borax (sodium tetraborate decahydrate) to freshly-cut stump surfaces. The application would be applied to stumps of trees of 14 inches in diameter and greater where they are within 200 feet of striking roads and other main travel routes. The material is typically applied at a rate of one pound per 50 square feet of stump surface. The stumps are treated the same day or within 24 hours of being cut.

According to the Human Health and Ecological Risk Assessment for Borax Final Report there is a limited potential to contaminate water (USDA Forest Service 2006). The report goes over two different scenarios for the contamination of water, one being an accidental spill into a small pond where a young child consumes the contaminated water and the other a model for determining the concentration of boron (boric acid) in a stream. According to the spill scenario, the concentration of boron can range from about 0.3 to 1.3 mg B/L if 6.25 to 25 lbs. of borax is accidently spilled into a small pond; this is within the range of naturally occurring concentrations of boron in water (USDA Forest Service 2006). The other scenario uses GLEAMS (Groundwater Loading Effects of Agricultural Management Systems) modeling to estimate reduction in Borax concentration in a stream due to runoff, sediment and percolation (USDA Forest Service 2006). According to the models assumptions, the runoff water and base flow diluted the concentration of boric acid to very low and essentially negligible values (USDA Forest Service 2006). **If trees of 14 inches in diameter and greater are cut down within the standard RCA buffers they will not be treated with borax.** Under the action alternatives the application of borax to freshly-cut stumps will not have significant effects to water quality.

Under the no action alternative borax would not be applied on NFS lands therefore there would be no potential contamination to water in the analysis area and no cumulative effects. It is presently unknown if borax has been applied on private timberlands within the analysis area. However, given the low toxicity and low ambient concentrations of borax that could result from the proposed borax application, it is unlikely that there would be observable cumulative effects from the proposed action in combination with any other use of borax in the area. Expected quantities of boron added to the water via runoff from borax application areas are considerably lower than average background levels in water (USDA Forest

Service 2006), therefore there is minimal to no risk to cumulative effects to water quality from the proposed borax application.

Analysis Methodology

The analysis will use two measures to compare the two action alternatives with the no action alternative. These measures are Riparian Conservation (RCA) acres treated and Equivalent Roaded Acres (ERA). Both measures will reference the beneficial uses associated with the waters located in their subwatersheds (see Table 4). RCA acres treated is a measure that will be used to address direct and indirect effects and how it may impact water quality and any other beneficial uses. Equivalent Roaded Acres (ERA) is a measure used to address cumulative effects to water quality. A more detailed description of the identified beneficial uses is in the Riparian Conservation Objective (RCO) Analysis in the project file.

Table 4. Beneficial Uses by Subwatershed

Beneficial Use	Englebright Dam to Feather River
Municipal and domestic water supply	
Agricultural supply	- -
Irrigation	X
Stock Watering	X
Hydropower generation	X
Recreation	- -
Water contact recreation	X
Canoeing and rafting	X
Non-contact water recreation	X
Freshwater Habitat	- -
Warm	X
Cold	X
Migration	- -
Warm	X
Cold	X
Spawning	- -
Warm	X
Cold	X
Wildlife Habitat	X

- - = look at subcategory

Measurement Indicator: Riparian Habitat Resiliency

Riparian Conservation Areas Acres Treated

Short-term effect: less than 1year or 1 winter

Long-term effect: greater than 1 year or 1 winter

Data Sources:

- Field visits in the summer of 2015

Spatial Boundary: Project boundary for direct and indirect effects.

According to the SNFPA ROD, RCAs widths may be adjusted at the project level if a landscape analysis has been completed and site-specific RCO analysis demonstrates a need for different widths. A

landscape and RCO analysis was completed and indicates a need for different widths. The land designation/allocation of RCAs will remain the same except for treatment within these areas would be allowed to address habitat and fire resilience opportunities. Treatment within the RCAs would not conflict with Aquatic Management Strategy (AMS) goals, RCOs, and the landscape analysis. For a more detailed analysis see the RCO analysis which complies with AMS goals. The potential effects of allowing treatment within RCAs are described in the effects analysis and/or RCO analysis.

Measurement Indicator: Water Quality

Equivalent Roaded Acres (ERA)

Short-term effect: 1 year

Long-term effect: 25 years

Data Sources:

- Plumas National Forest (PNF) corporate GIS layers: fire history, ownership, and roads.
- National Hydrography Database (NHD) features such as waterbodies, springs, and streams.
- The records of past timber harvest activities on National Forest System (NFS) lands within the analysis area were extracted from the Forest Service Activity Tracking System (FACTS).
- Stream typing effort in the summer and fall of 2013.
- Timber Harvest Plans (THPs) for activities located on non-National Forest System lands were collected from the California Department of Forestry and Fire Protection (CALFIRE).
- Aerial photo interpretation

Spatial Boundary: Delineated subwatersheds.

The Cumulative Watershed Effects (CWE) analysis is based on the guidance from the Forest Service Handbook FSH 2509.22-Soil and Water Conservation, Region 5 Amendment (USDA Forest Service 1990). Effects may be either beneficial or adverse and are a result of combined effects of multiple management activities within a watershed. Beneficial uses for waters in the project watersheds include water recreation, terrestrial wildlife habitat, and cold freshwater habitat. Among these beneficial uses, aquatic habitat is the most sensitive to adverse water quality effects that could potentially result from land disturbing activities such as those proposed for this project. Alterations to watershed hydrology are believed to be the most probable mechanism for initiating these effects to aquatic habitat (USDA Forest Service 1990). The Region 5 Forest Service Handbook amendment utilizes conceptual site disturbance coefficients called equivalent roaded acres (ERA) to track changes in the hydrologic functioning of watersheds. ERA coefficients are used to compare the effect of management activities (e.g. timber harvest or pile burning) to the effect of a road in terms of altering surface runoff patterns and timing. The sum of these coefficients represents the percentage of watershed in road surface that would produce the same effects as the existing or planned distribution of management activities (Berg et al, 1996). The following land disturbing activities are evaluated in the ERA model for the Gibsonville Healthy Forest Restoration Project: roads, landings, timber harvesting activities on public and private lands, urbanization, and fire. These land-disturbing effects are assessed for the past 25 years, the present, and the foreseeable future. The analysis is based on geographic and land use information compiled from the Forest Service, CalFire, county databases, aerial photographic interpretation and field observations.

The response of the landscapes to land disturbances is influenced by climate, physiographic, geologic, and ecologic conditions (USDA Forest Service 1990). Therefore, recovery coefficients are assigned based on local conditions. The western slope of the Sierra Nevada within the Plumas National Forest area has a high rate of vegetative establishment and growth due to high annual precipitation and the presence of highly productive forest soils. On the Feather River Ranger District, 25 years is used as the average recovery period for disturbed sites as vegetation management is assumed to have no effect on hydrologic processes after 25 years. Other disturbances, such as roads, mining or urbanization receive no recovery coefficient as they recover more slowly or not at all.

Watersheds and stream channels have a natural capacity to absorb various levels of land disturbance without major adjustment to their function and condition. However, there is point where additive or synergistic effects of land use activities would cause a watershed to become highly susceptible to cumulative effects. This upper estimate of watershed "tolerance" to land use is described as the threshold of concern (TOC). When the sum of disturbances exceeds the TOC, water quality may be impaired for established beneficial uses, such as aquatic habitat. Stream channels and water quality can deteriorate to the point where adjacent riparian areas and wetlands become severely damaged.

Project level TOCs are estimated by considering the sensitivity of each analyzed watershed. Natural watershed sensitivity is an estimate of a watershed's ability to absorb land use impacts without increasing the effects of cumulative impacts to unacceptably high levels (USDA Forest Service 1990). Watershed sensitivity values where assigned to watersheds under the HFQLG Environmental Impact Statement, which considered the following factors: 1) soil erosion potential; 2) potential for high intensity and/or long duration precipitation events, including rain-on-snow; 3) potential for landslides and debris flows; and 4) the percentage of alluvial stream channels in the watershed (USDA Forest Service 1999). The projects subwatersheds fall within or adjacent to two former QLG subwatersheds (110012, 11006) and were rated as moderate for watershed sensitivity. The TOC generally ranges between 12 percent and 20 percent ERA depending upon the intrinsic sensitivity of the watershed and beneficial uses of water (USDA Forest Service 1990). For this project, the TOC has been conservatively set at 12 and 14 percent across project specific subwatersheds (see Table 6). The reason why the sensitivity rating for the former HFQLG watersheds were used is because the data used to determine those ratings are still relevant today. The ERA method for CWE analysis document in the project folder contains details of how these percentage numbers are assigned.

The ERA total of each subwatershed, expressed as a percentage of the subwatershed area, is compared to the TOC and reported as a fraction (percent) of the TOC. ERA totals in the range of 90 to 99 percent of TOC are considered to be approaching TOC, while those that are 100 percent or greater equal or exceed the TOC. The TOC does not represent an exact level of disturbance where cumulative watershed effects will begin to occur. Rather, it serves as an indicator of increased risk of significant adverse cumulative effects occurring within a watershed. If a subwatershed is above the TOC, a more thorough analysis of the activities planned within the watershed is necessary.

Environmental Consequences

Alternative A: Direct and Indirect Effects

Measurement Indicator: Riparian Habitat Resiliency

Riparian Conservation Areas Acres Treated

The number of RCA acres found in the project boundary is 616.9. The number of acres treated in RCAs under this alternative is zero. The beneficial uses associated with the project waters will not be impacted with the selection of the no action alternative since nothing occurs. Although nothing occurs under this alternative data was collected to get a snap shot of stand structures within RCAs. Common stand exam plots where contracted out on 3 streams within the project boundary. Each stream had 3 primary locations where the plots were installed. Within each primary location a total of 3 plots were conducted therefore each stream had 9 plots for a total of 27 plots for the project. At every primary location the first plot was installed 10 feet from the right bank of the stream, the second plot placed 100 feet left (left bank of the stream) from the first plot and the third plot 100 feet to the right of the first plot. Plots 2 and 3 where placed perpendicular to plot 1 along the contour. Table 5 displays the results of the common stand exams.

The stand/stream ID column are the streams that were surveyed. The 9 plots per stream the data was compiled into one. The canopy cover for stream 809 is 68.3 percent while the canopy cover without saplings (trees less than 6 inches in DBH) is 60.7 percent. The average canopy cover for all 3 streams is 63 percent while the canopy cover without saplings is 52.6 percent. The average total trees per acre for all 3 streams is 995.8 while the average total trees without samplings is 113.5 which is significant difference.

Table 5. Common stand exams in RCAs

			Trees Per Acre						
	Canopy Cover Percent		Sapling	Pole	Small	Med.	Large	Tot.	Tot. w/out Saplings
Stand / Stream ID	0-99" DBH	6-99" DBH	0-6" DBH	6-11" DBH	11-24" DBH	24-30" DBH	>30" DBH	0-99" DBH	6-99" DBH
809	68.3	60.7	646.8	56.0	64.3	19.2	22.2	808.6	161.7
855	64.6	50.1	1134.0	40.6	88.3	12.1	9.0	1284.0	150.0
970	56.0	47.0	806.1	10.8	37.0	16.5	24.4	894.9	88.7
Avg.	63.0	52.6	862.3	35.8	63.2	16.0	18.5	995.8	133.5

Alternative A: Cumulative Effects

Measurement Indicator: Water Quality

Equivalent Roaded Acres (ERA)

The ERA model analyzed what the existing condition would be for 2017, which is the proposed year for the project to be implemented. It takes into account past, present, and future foreseeable management

activities. Detailed past, present and foreseeable future activities by land ownership can be found in the project file. Table 6 displays the percent TOC of all of the subwatersheds analyzed for this project. As discussed above in the methodology section if the percent TOC is equal to or greater than 100 percent TOC then a more thorough assessment of the activities occurring in those subwatersheds would have to occur. All the subwatersheds are well below TOC. The highest percent TOC is found in subwatershed 4 at 45 percent while the lowest is found in subwatershed 5 at 3 percent. Table 7 displays what are the biggest contributors by subwatershed. The biggest contributor of ERAs are roads and trails for all the subwatersheds except for subwatershed 4 where 53 percent comes from private timber management activities. No subwatershed under the predicted condition for 2017 will be over TOC therefore significant changes to runoff patterns and discharge timing is not anticipated resulting in the hydrologic function of the watersheds to remain intact.

Table 6. Percent TOC by subwatershed

Watershed Number	Area (Acres)	TOC Level	ERA's needed to be at TOC	Sum of ERA's	Percent TOC
1	1,016	14%	142	22.1	16%
2	1,053	14%	147	13.7	9%
3	1,189	14%	167	37.5	23%
4	1,312	12%	157	70.6	45%
5	760	14%	106	2.9	3%

Table 7. Percent Contribution to ERA's by subwatershed

Subwatershed Number	Private Land	Forest Service Land	Roads and Trails
1	25.5%	0%	74.5%
2	0%	0.7%	99.3%
3	19%	14.9%	66.1
4	53%	4.7%	42.2%
5	0%	0%	100%

Alternative B: Direct and Indirect Effects

Measurement Indicator: Riparian Habitat Resiliency

Riparian Conservation Areas Acres Treated

Some of the goals of the project is to initiate aspen regeneration via the removal of competing conifers, improve meadow vitality, and improve the fuels conditions across the landscape to minimize the effects of a wildfire. Under existing condition the flame lengths are too high and the canopy base height are to low which can be a recipe for a passive to active crown fire. By moving forward with the proposed treatments the goal is to reduce the flame lengths to below 4 feet and raise the canopy base height to a point where the fire type changes from a passive crown to a surface fire (refer to the fuels section for more details). According to PSW-GTR-247 fire behavior in riparian areas vary with landscape attributes. Of the papers that they synthesized the found that generally that larger (4th order and higher) streams often burned less frequent and less severe due to the moisture microclimates whereas smaller, headwater streams often burned similarly to adjacent uplands (USDA Forest Service 2014). The majority of streams found within the project boundary are 1st through 3rd order streams and the common stand exam data collected for the project does indicate that the RCAs have a high tree density. The high tree

density and several years of drought does make these riparian areas more susceptible to act as fire wicks that can carry a high-intensity fire. In order to improve RCAs resiliency treatments within these areas was allowed.

A total of 1,101.3 acres (Table 8) potentially could be treated within RCAs under this alternative which is greater than the 616.9 acres of RCAs found in the project boundary. The reason why for the higher acres is because the footprint of the RCAs may potentially be treated more than once. Some of these areas may see up to 3 treatments at some point but not all at once. The total potential mechanical treatment in RCAs is 318.4 acres while the total potential hand treatment work in RCAs is 336.7 acres which excludes 446.2 acres of underburning. Table 9 below is the allowed treatments within RCAs while adhering to the RCOs and BMP 1.8 streamside management zone designation.

Table 8. RCA acres treated by treatment type

Treatment Type	Alternative B	Alternative C
Aspen Release	15.1	15.1
Variable Density Thinning (VDT)	86.5	64.9
Roadside Hazard	32.4	32.4
Mastication	53.9	53.9
Biomass Removal	130.5	108.9
Subtotal	**318.4**	**275.2**
Meadow Restoration	8.8	8.8
Riparian Restoration	15.2	15.2
Hand Cut Pile Burn (HCPB)	312.7	334.5
Subtotal	**336.7**	**358.6**
Underburn (UB)	446.2	432.3
Total Potential Treatments Within RCAs	**1101.3**	**1066.0**

*Acres presented here are best estimates using GIS which may be underestimating the acres treated due to the different treatments along the same RCA feature. Purpose of table is to show a comparison between the alternatives. Treatments on the ground will fallow the allowable treatments within RCAs as indicated in Table 9.

Table 9. Allowable treatment within RCAs by treatment type

Treatment Type	Ephemeral and Intermittent Streams*	Perennial	Springs	Meadow
Variable Density Thinning	Equipment exclusion zone.		Within stream buffers or as identified.	To meadow edge.
	Apply a 75 ft. buffer.	Apply a 150 ft. buffer.		
Aspen Release	Equipment exclusion zone. Apply a 10 ft. buffer.		Within stream buffers or as identified.	To meadow edge.
Mastication	Equipment exclusion zone.		Within stream buffers or as identified.	To meadow edge. Minimize the amount of slash into meadow.
	Apply a 50 ft. buffer.	Apply a 75 ft. buffer.		
Roadside Hazard	Equipment exclusion zone.		Within stream buffers or as identified.	N/A
	Apply a 75 ft. buffer.	Apply a 150 ft. buffer.		

Treatment Type	Ephemeral and Intermittent Streams*	Perennial	Springs	Meadow
Biomass Removal	*Follow the previous mechanical treatment buffers for RCA. *For example variable density thinning buffer for perennial stream is 150 ft. No mechanical treatment within this buffer.		Within stream buffers or as identified.	To meadow edge.
Hand Cut Pile Burn	*May hand cut up to 10" DBH within entire riparian allocation area. *Piles should be at least 25 ft. from the edge of stream bank or spring. *Piles may be ignited independent of an underburn.			To meadow edge.
Meadow Restoration	*May hand cut up to 16 inches in DBH within entire riparian allocation area regardless the type of stream or if it's a spring. The hand cutting limits also applies to treatment within meadows. *Piles should be at least 25 ft. from the edge of stream bank or spring. It's fine to pile within meadows. Burn piles may be ignited independent of an underburn.			
Riparian Restoration	*May hand cut up to 16 inches in DBH within entire riparian allocation area regard less the type of stream or if it's a spring. The hand cutting limits also applies to treatment within meadows. *Piles should be at least 25 ft. from the edge of stream bank or spring. It's fine to pile within meadows. Burn piles may be ignited independent of an underburn. *Unit R01: May hand cut conifers up to 16 inches in DBH inside meadows and out to 75 feet from meadow edge will be felled. May pile within meadow but if stream is present then places piles at least 25 ft. from stream.			
Underburn	*Underburn will be allowed within the RCA. *Fire will be ignited no closer than 150 ft. away from any stream, spring, and meadow allowed to back into these features under the ideal conditions for underburning.			

* Incudes Alder but go with whatever is greater

A total of 86.5 acres of variable density thinning (VDT) is proposed to occur within RCAs and defined equipment exclusion buffers will be in place to be effective for buffering/filtering any potential surface runoff due to the activity. Other BMPs will help minimize the potential for surface runoff from reaching any stream. Some of these BMPs include: 1.8 Streamside Management Zone designation, 1.9 determining tractor-loggable ground, 1.05 limiting operating period (LOP),1.12 log landing location, 1.16 log landing erosion control, 1.17 erosion control on skid trails, and 1.19 erosion-control structure maintenance. The project BMPs and design features are listed in the management requirements table for the project. The treatment will not change the water quality or its beneficial uses.

BMPs are used in most all Forest Service management activities and their effectiveness is important for various reasons. The BMP Evaluation Program (USDA Forest Service 2002) was developed to reduce the risk to water quality degradation by assessing the implementation and effectiveness of BMPs. The objective of BMPs is to protect water related beneficial uses from nonpoint source containments (USDA Forest Service 2000). Results from the BMP Evaluation Program are used to assess direct and indirect effects of water quality for the proposed action. Proper application of BMPs minimizes erosion, such as

rilling, and sediment delivery to nearby streams. The BMP Evaluation Program rates two components: the effectiveness of the BMPs and whether or not BMPs were properly implemented. The recent Region 5 amendment to the Forest Service Handbook for water quality management indicates Forests should strive to achieve BMP effectiveness rates of 90% to 95% (USDA Forest Service 2011). The Region 5 amendment states that BMP monitoring frequency may be reduced for evaluation protocols that rate at least 95% effective for 5 consecutive years. Additionally, the Handbook amendment states that the Forest Service will work with the California State Water Resource Control Board to revise and improve particular BMPs if effectiveness rates are less than 90%.

BMP evaluations conducted on the Plumas National Forest for activities that are pertinent to Alternative B are evaluations T01, T02, T04, E08, E09, E11 and F25 as indicated in Table 10. The Plumas National Forest Report for the Best Management Practices Evaluation Program 2010-2012 report found that 93.8 percent were rated as effective between 2010 and 2012. From 2007-2012 the report found that 90.5 percent were effective. From 2010-2012 the timber associated BMPs for implementation were rated as 100 percent and for 2007-2012 they were rated as 98.1 percent (USDA Forest Service 2013). Standard practice on Plumas NF has been to visit all sites where a BMP evaluation indicated substandard effectiveness, correct the practice on the ground at that location, and consider how the practice may be improved during implementation of future projects. Alternative B has the potential to directly and/or indirectly affect water quality and associated beneficial uses but the potential is low due to the implementation and effectiveness rate that the BMP program demonstrated. Providing adequate protection buffers to streams, as well as use of effective nonpoint source pollution prevention measures, would greatly reduce the potential of sediment reaching stream channels within and downstream of proposed treatment units. BMPs apply to all the proposed treatments but not all the treatments will have the same number or combination of BMPs. Mastication units will adhere to BMP 1-05 (a soils LOP) and 1-8 (stream management zone designation, i.e. Table 9)

Table 10. BMPEP for Timber Activities

BMPEP Onsite Evaluation Protocols	**BMP subjects Evaluated**
T01: Streamside Management Zones (SMZs)	• Stream Management Zone (SMZ) Designation • Stream Course and Aquatic Protection • Slash Treatment in Sensitive Areas
T02: Skid Trails	• Tractor Skidding Design • Erosion Control on Skid Trails
T04: Landings	• Log Landing Location • Log Landing Erosion Control
E08: Road Surface, Drainage & Slope Protection	• Erosion Control Plan • Stabilization of Road Slope Surfaces and Spoil Disposal Areas • Road Slope Stabilization Construction Practices • Control of Drainage • Construction of Stable Embankments • Maintenance of Roads • Road Surface Treatments to Prevent Loss of Materials
E09: Stream Crossings	• General Guidelines for Location and Design of Roads • Stabilization of Road Slope Surfaces and Spoil Disposal Areas • Road Slope Stabilization Construction Practices

BMPEP Onsite Evaluation Protocols	BMP subjects Evaluated
	• Control of Road Drainage • Construction of Stable Embankments (Fills) • Stabilization of Road Slope Surfaces and Spoil Disposal Areas
E11: Control of Sidecast Material	• Control of Sidecast Material During Construction & Maintenance
F25: Prescribed Fire	• Consideration of Water Quality in Formulating Fire Prescriptions • Protection of Water Quality from Prescribed Burning Effects

A total of 53.9 acres of mastication is proposed to be treated within the RCAs which is unlikely to produce additional surface runoff because the treatment creates more surface soil cover which is an important component in the formation and slowing down of runoff. The goal of masticating is that it takes the ladder fuels and it rearranges them to surface fuels. The masticator equipment will be limited by the equipment exclusion zone along RCAs as identified in Table 9. Within the equipment exclusion zone hand cutting of conifers up to 10 inches in DBH would be allowed and the piles would be place 25 feet away from any stream bank. Masticating along RCAs will not change water quality and its beneficial uses.

A total of 32.4 acres of roadside hazard tree removal is proposed to be treated within the RCAs. Within the equipment exclusion zone hazard trees may be felled. The removal of hazard trees should be less intensive on the landscape than VDT unless the conditions change by the time the project is implemented. The removal of hazard trees will not change the water quality or its beneficial uses.

A total of 130.5 acres of biomass removal is proposed to be treated within RCAs. Biomass removal is the removal of surface and ladder fuels (trees 3-9.9 inches in DBH). This treatment allows the option for these trees to be sold for small log uses rather than cut, piled and burned on site. There was an assumption made when determining the acres treated within RCAs. The assumption was that if the treatment is identified with some kind of mechanical treatment then it would fallow those equipment exclusion zone buffers.

Alternative B proposed 22.8 acres of aspen release of those acres 15.1 are within RCAs. The reason why for the high percentage of acres treated within the RCAs is because of the buffer chosen for the streams, springs, and meadows. Shading from competition leaves aspen vulnerable to disease and infection and inhibits successful growth and vitality of sucker as well as mature trees. The intent of the treatment is to initiate aspen regeneration via the removal of competing conifers which stimulates the sprouting process, along with warmer soil temperatures and increased sunlight (Sheppard 1993). Removing conifer competition would meet the specific requirements needed to initiate aspen regeneration as well as provide an ideal microclimate for viable sucker growth (Doucet 1989; Navratil 1991). The intent is to take down the canopy cover down to 10-15 percent and keep trees larger 30 inches in DBH. The number of miles affected by the aspen release treatment is 0.82 miles.

All the mechanical treatment units that have hand cut pile burn (HCPB) can be treated within the equipment exclusion zone. The hand cutting of shrubs and trees is up to 10 inches in DBH removes the saplings and poles trees adjacent to the riparian feature. As presented in Table 5 by simply removing

(treat) the saplings (0-6" DBH) the average percent canopy cover can change by 10.4 percent. This does not even include the treatment of the 6-10" DBH material. The change in percent canopy cover is not exact it's qualitative but it does illustrate that it does change. Depending of mechanical treatment proximity to the RCA feature plus the HCPB within the equipment exclusion zone buffer the exact percent canopy cover is unknown because it was not modeled. Table 5 shows that the average total tree per acre is 995.8, by simply hand cutting within the RCAs the number of trees per acres decrease to 97.7. The assumption is the saplings and poles classes are treated/removed. Although the pole tree class ranges from 6-11 inches in DBH which is 1 inch greater than what the HCPB treatment it's still a good approximation and representation of how ground and ladder fuels are reduced. The reduction of ground and ladder fuels will make the RCAs more fire resilient.

Hand cutting within the entire stream allocation area regardless of the type of stream will be allowed. Burn piles may be ignited independent of an underburn. Piles should be at least 25 ft. from the edge of stream bank or spring. Hand cutting would be allowed up to the meadows perimeter and within. Piles may be piled within the meadow. Hand cutting up to the springs will be allowed but the piles should be 25 feet away. Hand cutting conifers up to 10 inches in DBH applies across the entire project regardless if it's in or out of an RCA. The hand treatment within RCAs will not change the water quality or its beneficial uses because the activity does not significant change effective soil cover to promote erosion or the canopy to change the water temperature of steams. The hand cut pile burn treatments within RCAs are intended to help reduce the fuels before underburning. The discussion above about the changes in percent canopy cover and trees per acre applies to this treatment.

Alternative B has 8.8 acres of meadow restoration prescribed while 15.2 acres of riparian restoration are prescribed. Both will HCPB shrubs and trees up to 16 inches in DBH within entire riparian allocation area regardless the type of stream or if it's a spring. The hand cutting limits also applies to treatment within meadows. Piles should be at least 25 ft. from the edge of stream bank or spring. It's fine to pile within meadows. The intent is to remove the encroaching conifers. The treatments will not change the water quality or its beneficial uses.

A total of 446.2 acres of underburn will be allowed within the RCAs. Fire will be ignited no closer than 150 ft. away from any stream, spring, and meadow. Underburn will be allowed to back into these features under the ideal conditions. Underburning in this project is a primary, secondary or tertiary treatment type. The BMP Evaluation Program from 2010-2012 found that prescribed fire (F25) BMPs were rated at 100 percent for implementation and 97 percent for effectiveness (USDA Forest Service 2013). The high success rate of implementation and effectiveness of BMPs when conducting underburns means that the Forest Service met or exceed project identified effective soil cover, and little or no hydrophobic soils and rilling was observed. The utilization of BMPs, design features and proper buffers for RCAs is crucial to treating within RCAs; this would make them more fire resilient yet not jeopardize the RCAs and its associated beneficial uses.

Alternative B: Cumulative Effects

Equivalent Roaded Acres (ERA)

For the proposed action, the ERA model analyzed for what conditions would be like upon completion of the project. It adds the effects of the proposed action onto the existing condition. The model's assumption is that all the proposed actions would occur within one year but in reality that doesn't occur all the time. The model looks at worst a case scenario that is used to identify watersheds that may need a closer look at cumulative watershed effects that may have a negative or adverse effect to beneficial uses. The beneficial uses for the project are identified in Table 4 and RCO Analysis in the project file. The implementation of proposed activities may take up to 10 years due to various factors. One factor is funding, for example the Forest Service may have limited funding to cruise and layout units in any given year. Service work (mastication, hand cut pile burn, underburn) at times is dependent on Knutson Vandenberg (KV) funding, grants, and Forest Service funds. Another factor is that the purchaser of timber contract determines when they work and complete the treatments. The market influences the contract purchaser actions too. Weather and politics determine if and when prescribed pile burning and underburning occur. Analysis results of the ERA model indicate that the proposed project increased the percent TOC across all subwatersheds.

According to Table 11 the range of percent TOC is 19 to 50 percent. The largest increase in percent TOC occurred in the following subwatersheds 3, 2, and 1 with corresponding increases of 27 percent, 22 percent, and 20 percent. Table 12 shows how the various components to the ERA model had their percentage ERA contributions change due to the proposed action. The end result is the ERA model indicates that none of the subwatersheds should experience any cumulative effects because all the subwatersheds are well below the threshold of concern. Based on the ERA modeling for this alternative, the cumulative effects of all past, present and foreseeable future activities within the analysis area, coupled with the implementation of the proposed action with BMPs, and design features would not alter surface runoff patterns and timing enough to significantly impact water quality or affect beneficial uses of water.

Table 11. Percent TOC by subwatershed for Alternative B

Subwatershed Number	ERA's needed to be at TOC	Sum of ERA's	Percent TOC	Difference in Percent TOC Between Alt. A and Alt. B
1	142	50.0	35%	20%
2	147	45.6	31%	22%
3	167	83.1	50%	27%
4	157	74.9	48%	3%
5	106	19.7	19%	16%

Table 12. Percent Contribution to ERA's by subwatershed for Alternative B

Subwatershed Number	Private Land	Forest Service Land	Roads and Trails	Alt. B Activities
1	11.3%	0%	32.9%	55.9%
2	0%	0.1%	30%	69.9%
3	8.4%	5.9%	29.8%	55.9%
4	37%	4.4%	39.8%	18.8%
5	0%	0%	14.8%	85.2%

Alternative C: Direct and Indirect Effects

Measurement Indicator: Riparian Habitat Resiliency

Riparian Conservation Areas Acres Treated

There is no difference in treatment acres for the fallowing treatment types across the two action alternatives: aspen release, mastication, meadow restoration, riparian restoration, and roadside hazard. Biomass removal, underburn and variable density thinning saw decreases in acres treated of 21.6, 13.9 and 21.6 acres, respectively when compared to Alternative B. Alternative C proposes 21.8 more acres of treatment within RCAs when compared to Alternative B. A total of 1,066.0 acres could be potential treated in RCAs. The analysis conducted under Alternative B for this measure applies to this alternative and the selection of this alternative will not have change the water quality or its beneficial uses.

Alternative C: Cumulative Effects

The proposed project under this alternative increased the percent TOC across all subwatersheds when compared to the existing condition. According to Table 13 the range of percent TOC is 9 to 48 percent. The largest increase in percent TOC occurred in the following subwatersheds 3, 2, and 1 with corresponding increases of 23 percent, 22 percent, and 16 percent. The biggest contrast between alternative B and alternative C is found in subwatershed 5, when both alternatives are compared to the existing condition; under alternative C the subwatershed has only a 6 percent increase in TOC while alternative B shows a 16 percent increase in TOC.

The end result is the ERA model indicates that none of the subwatersheds should experience any cumulative effects because all the subwatersheds are well below the threshold of concern. Based on the ERA modeling for this alternative, the cumulative effects of all past, present and foreseeable future activities within the analysis area, coupled with the implementation of the proposed action with BMPs, and design features would not alter surface runoff patterns and timing enough to significantly impact water quality or affect beneficial uses of water.

Table 13. Percent TOC by subwatershed for Alternative C

Subwatershed Number	ERA's needed to be at TOC	Sum of ERA's	Percent TOC	Difference in Percent TOC Between Alt. A and Alt. C
1	142	44.6	31%	16%
2	147	45.6	31%	22%
3	167	76.3	46%	23%
4	157	74.9	48%	3%
5	106	9.1	9%	6%

Table 14. Percent Contribution to ERA's by subwatershed for Alternative C

Subwatershed Number	Private Land	Forest Service Land	Roads and Trails	Alt. C Activities
1	12.6%	0%	36.9%	50.4%
2	0%	0.1%	30%	69.9%
3	8.6%	4.1%	32.5%	54.8%
4	37%	4.4%	39.8%	18.8%
5	0%	0%	32.3%	67.7%

Compliance with the Forest Plan and Other Direction

The project will be in compliance with the conditional waiver of waste discharge as directed by the California Regional Water Quality Control Board. The waiver also imposes conditions and requirements for agency monitoring. Implementation monitoring is required for all projects and consists of non-random pre- and post-winter inspection of project Best Management Practices (BMPs) during the course of timber harvest activities. The use of BMPs is consistent with the state's water quality management program for non-point source pollution as described in the Water Quality Management for Forest System Lands in California (2000). The use of BMPs reduces the potential of pollution reaching a stream and degrading water quality, and therefore protects the beneficial uses identified by the California Regional Water Quality Control, in compliance with California State law. The alternatives are consistent with the SNFPA FSEIS and LRMP. Proposed treatments within the riparian protection buffers are consistent with the RCOs as discussed in the project file.

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